



Municipal Utilities Exploring Solar Options for Communities

Emerson Reiter, NREL Project Lead
Amanda Stephens, Pasadena Energy Programs Manager
Donald Chung, NREL Senior Project Lead
Brian Newton, Utility Manager for Fremont, Nebraska

**Distributed Generation
Interconnection
Collaborative (DGIC)**
December 8, 2016

Agenda

Introduction - Emerson Reiter, NREL

Solar + Storage in Pasadena, CA

- Introduction - Amanda Stevens, Pasadena Water and Power
- Analysis and Results - Donald Chung, NREL


Community Solar in Fremont, NE

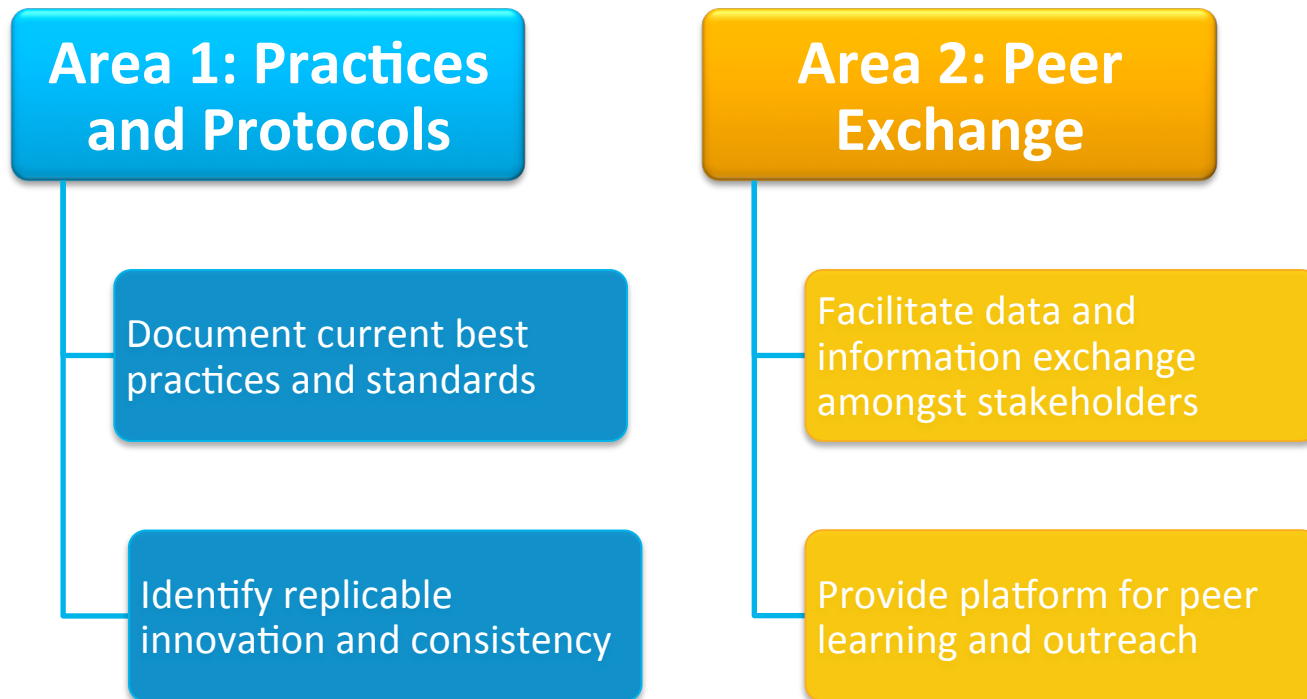
- Introduction - Brian Newton, Fremont Department of Utilities
- Analysis and Results - Emerson Reiter, NREL

Question & Answer

DGIC Background

Distributed Generation Interconnection Collaborative (DGIC)

- Supported by the U.S. DOE SunShot initiative 
- Launched following a stakeholder workshop in Oct 2013
- Has executed 15 webinars to date



DGIC Planned 2017 Activities

Area 1: Practices and Protocols

Develop case studies on leading interconnection practices based on peer nomination

Execute data analysis on pre-application reporting for interconnection applicants

Curate and share cutting-edge DG research from DOE programs

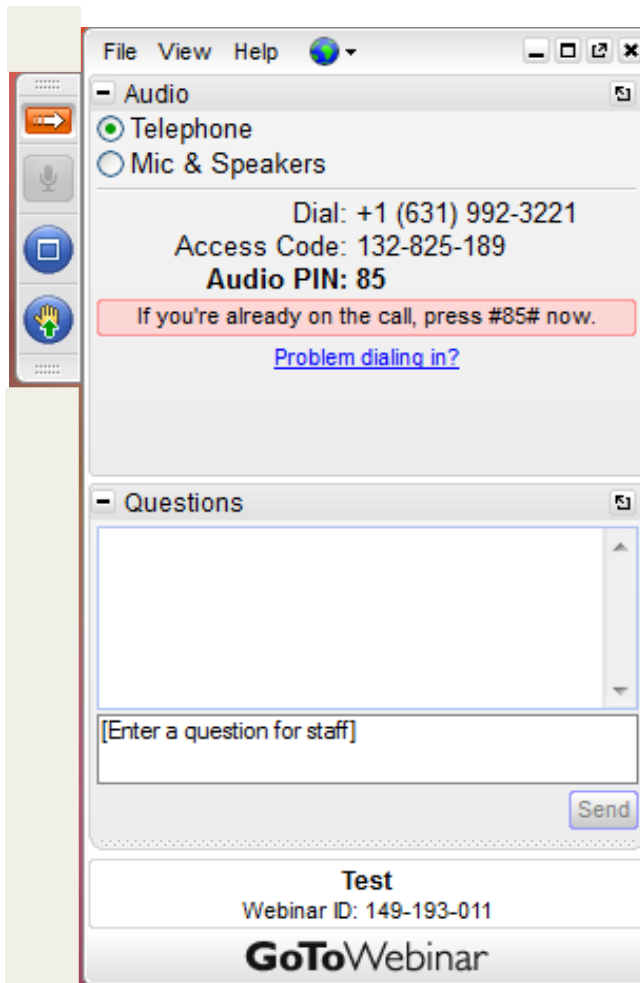
Area 2: Peer Exchange

Publish “lessons learned” on community solar for municipal utilities (late 2016)

Redesign DGIC website (go-live in January 2017)

Hold four quarterly webinars with utility & industry experts

Logistics



Participants are joined in listen-only mode.

← Use the Q&A panel to ask questions during the webinar.

← To ask a question: Type your question in the Q&A GoToWebinar toolbar.

The webinar is being recorded and will be posted on the DGIC site:
http://www.nrel.gov/tech_deployment/dgic.html

Speakers



Amanda Stevens
Energy Programs Manager
Pasadena Water and Power
California



Donald Chung
Senior Project Lead
NREL
Colorado



Brian Newton
Utility General Manager for the
City of Fremont
Nebraska



Emerson Reiter
Project Lead (DGIC
Moderator and
Presenter)
NREL



Pasadena Water and Power

Webinar - DGIC: Key Outcomes of NREL's Utility Technical Assistance Program Introduction to Pasadena Water and Power

Amanda Stevens
Manager, Energy Programs
December 8, 2016





Background on Pasadena Water and Power

Pasadena Water and Power

- Community-owned utility since 1906, providing electric and water to the Pasadena service territory
 - > Population of 141,510
- 23 square miles of service territory
- 678 miles of distribution
- 1,130,000 MWh in annual retail sales
- 320 MW system peak (2010)
- 65,569 retail energy services





PWP's Renewable Energy Initiatives

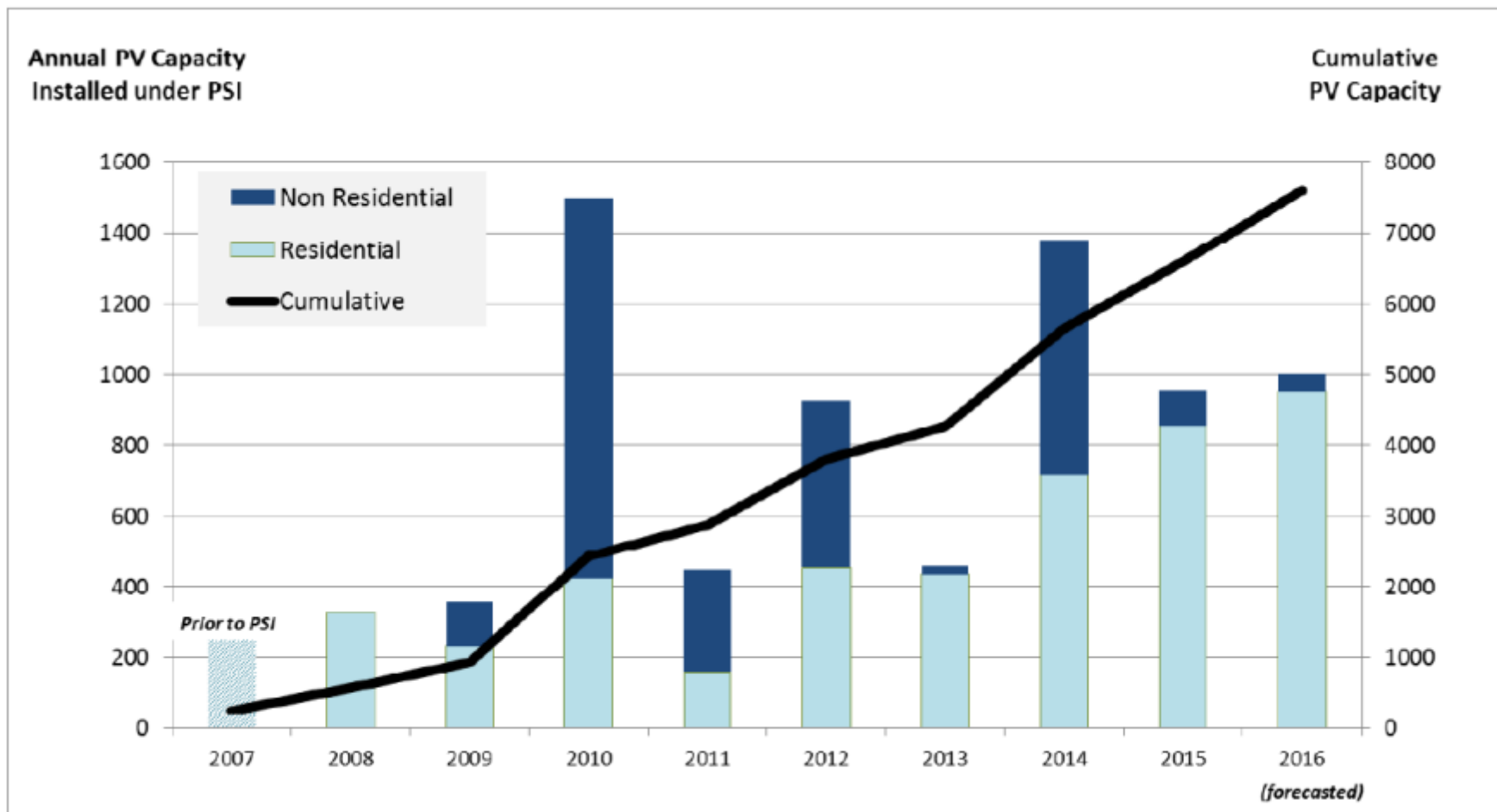
Pasadena Water and Power

- RPS goal of 40% renewable energy by 2020
 - > Currently at 30%
- Ongoing support for local, distributed solar generation:
 - > Pasadena Solar Initiative launched in 2008
 - Rebates and education
 - Net energy metering compensation for net surplus
 - > Goal of 14 MW by 2017
 - > Rebates have been gradually reduced; now at \$0.30/Watt (vary by customer class/system size)



Distributed PV Capacity Installed in Pasadena

Pasadena Water and Power





New Program Development – Community Solar

Key Objectives

Pasadena Water and Power

- Support PWP customers' interest in local solar power.
 - > Design a program that is attractive for customers while being viable and sustainable for PWP.
 - > **Simplicity is important**, both for customers and program administrator.
- Fulfill PWP commitment to develop a community solar program made in the 2015 Integrated Resource Plan.
- Advance Pasadena's renewable energy (14 MW solar under Pasadena Solar Initiative) and GHG goals.
- Program is funded by participants.



Community Solar Program Development

Pasadena Water and Power

Late-2015 thru 2016

- ✓ *Research options and project economics*
- ✓ *Develop program design with input from Pasadena community*
- ✓ **Select site & issue RFP ← We are here**

2017 (tentative)

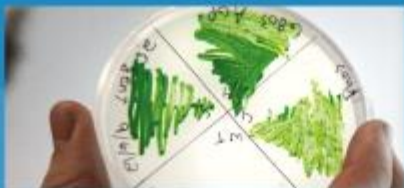
- ✓ *Receive final approval for contract and program*
- ✓ *Build PV system*
- ✓ *Market program and enroll customers*
- ✓ *Administer program & evaluate*



Research Questions – Community PV + Storage?

Pasadena Water and Power

- What are the economics for a locally-sited community solar PV system?
- Several potential Pasadena sites identified for NREL analytical team
 - > solar carport or rooftop
 - > 0.3 - 1.0 MW (per site)
 - > Opportunity for adding battery storage??
- More specifically - could battery storage be integrated to provide additional benefits to the host site (peak shaving), in lieu of a lease payment?



Utility Technical Assistance Pasadena Water and Power

Donald Chung
NREL Senior Project Lead



December 8, 2016

Analysis Purpose

- **Analyze potential for a community solar system hosted at several City of Pasadena sites.**
 - Rooftop and carport systems are both possible at the sites under consideration.
 - Rooftop and carport systems were analyzed separately, due to a large difference in installed cost
 - Sensitivity analysis was performed for key assumption values, including system cost, escalation rates, and developer IRR
- **Analyze the potential for a community solar developer to provide BTM storage systems to landlords or building tenants in lieu of lease payments for use of rooftops/parking areas**

Analysis Approach

- **Community solar potential is analyzed by modeling LCOE and potential year-1 PPA pricing from a third-party owned (TPO) system using SAM**
 - Analysis assumes that a developer will finance and construct a system, and earn a return by selling power produced to community solar subscribers
 - The analysis produces a range of possible PPA pricing, which can be compared to the retail rates of potential subscribers to give a preliminary indication of financial feasibility.
 - Given the desktop nature of the modeling, sensitivity analysis was also performed for key assumption values, including system cost, escalation rates, and developer IRR
- **Economics of a BTM storage system are analyzed from the tenant perspective using REopt, and compared to the potential income from a roof/parking area lease.**

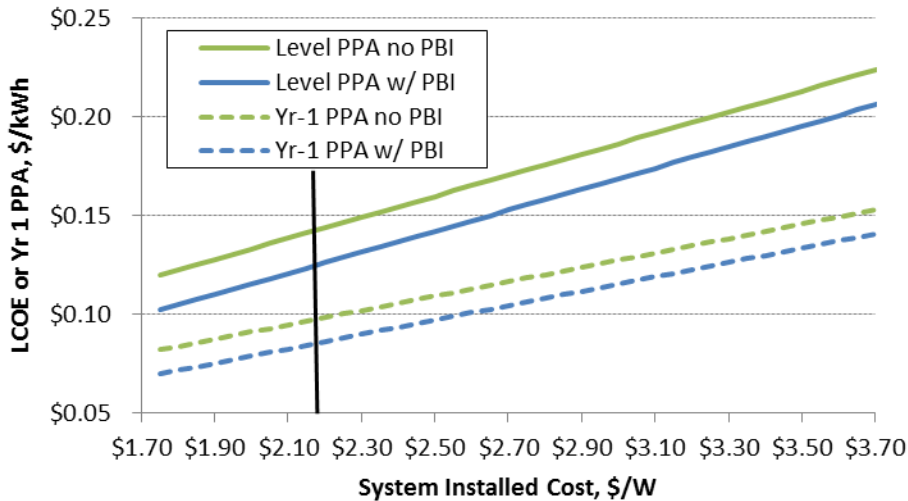
Rooftop Community System Parametric Analysis

BASELINE ASSUMPTIONS	
TPO IRR (after tax)	8.9%
TPO Federal tax rate	35%
TPO State tax rate	6%
TPO combined tax rate	38.9%
PPA/Utility rate escalator	4.5%
Analysis period, years	25
Array tilt, degrees	5
Array azimuth, degrees	180
System size, kW	1,355
Capital cost, \$/W	\$2.15
O&M cost, \$/kW-yr	\$15.00
Roof lease rate, \$/kW-yr	\$25.00
Roof lease, \$/yr	\$33,875
PBI, \$/kWh	\$0.096
PBI term, years	2

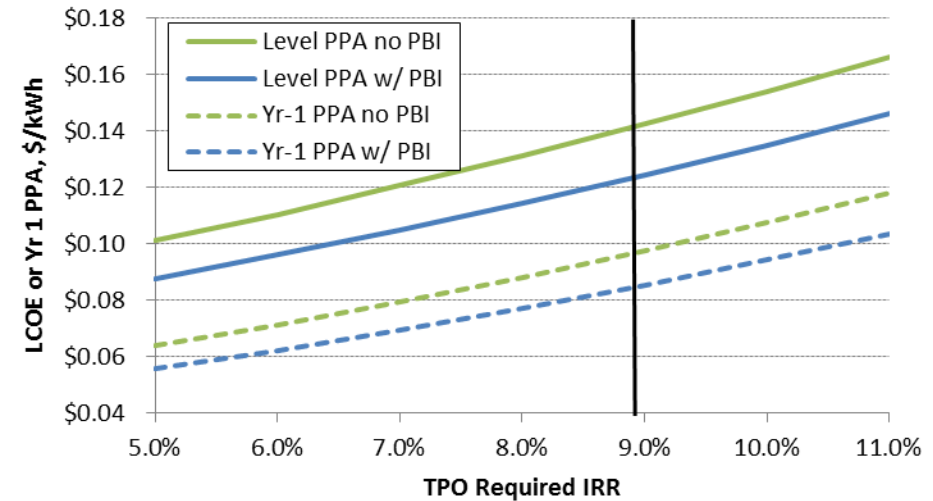
- Rooftop systems are preferred due to their lower capital cost (\$1/W less than typical carport installed costs)
- Buildings B and D are assumed to be capable of supporting a total of 1.355 MW
- The rooftop system is modeled as a single, 1.355 MW system
- Modeling and sensitivity analysis was conducted using NREL's SAM tool

Rooftop System Results

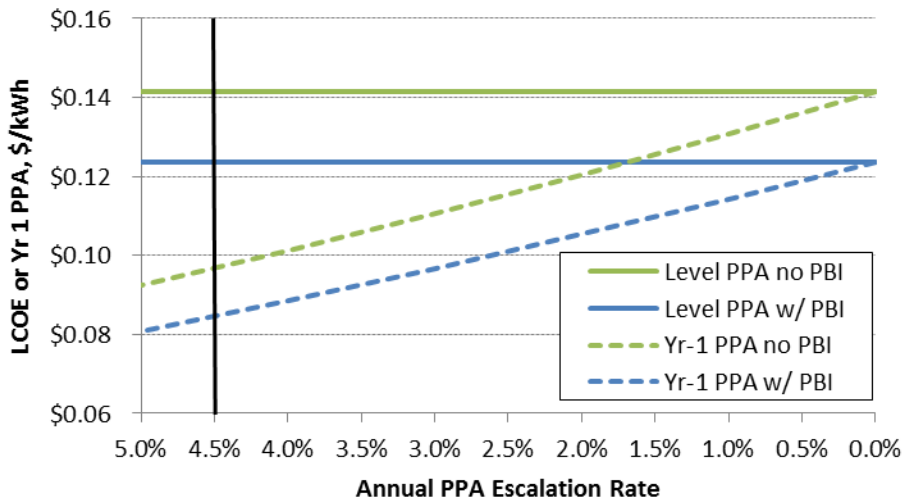
Levelized PPA, Yr-1 PPA vs. Installed Cost



Levelized and Yr-1 PPA vs. TPO IRR



Levelized and Yr-1 PPA vs. PPA Escalator



• PPA pricing is most sensitive to System Cost and Developer IRR

- Baselines: Cost = \$2.15/W; IRR = 8.9%; Escalation = 4.5%
- Sensitivity = pct change in Year 1 PPA/pct change in independent variable
- Cost sensitivity:
 - 0.93% with PBI
 - 0.81% without PBI
- IRR sensitivity:
 - 0.90% with PBI
 - 0.89% without PBI
- Escalator sensitivity:
 - -0.36% with PBI
 - -0.36% without

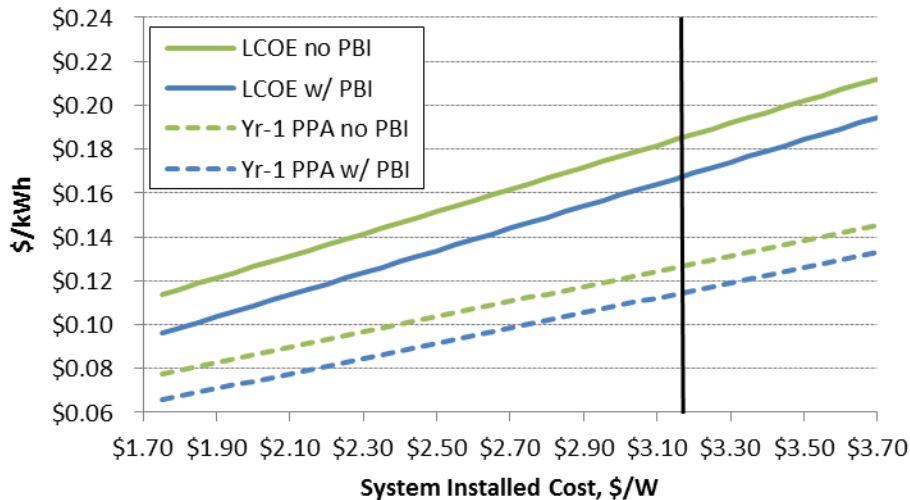
Carport Community System Parametric Analysis

BASELINE ASSUMPTIONS	
TPO IRR (after tax)	8.9%
TPO Federal tax rate	35%
TPO State tax rate	6%
TPO combined tax rate	38.9%
PPA/Utility rate escalator	4.5%
Analysis period, years	25
Array tilt, degrees	5
Array azimuth, degrees	180
System size, kW	1,355
Capital cost, \$/W	\$3.15
O&M cost, \$/kW-yr	\$15.00
Land lease rate, \$/kW-yr	\$25.00
Land lease, \$/yr	\$33,875
PBI, \$/kWh	\$0.096
PBI term, years	2

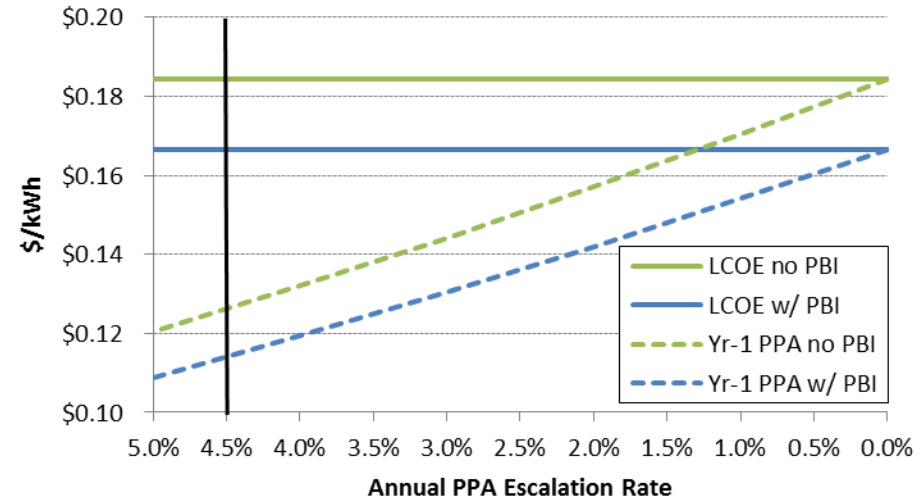
- Parking areas for buildings A and C are assumed to be capable of supporting a total of 1.5 MW of carports
- The carport system is modeled as a single, 1.355 MW system – the lower capacity compared to actual potential hosting capacity has no effect on these results
- Modeling and sensitivity analysis was conducted using NREL's SAM tool

Carport System Results

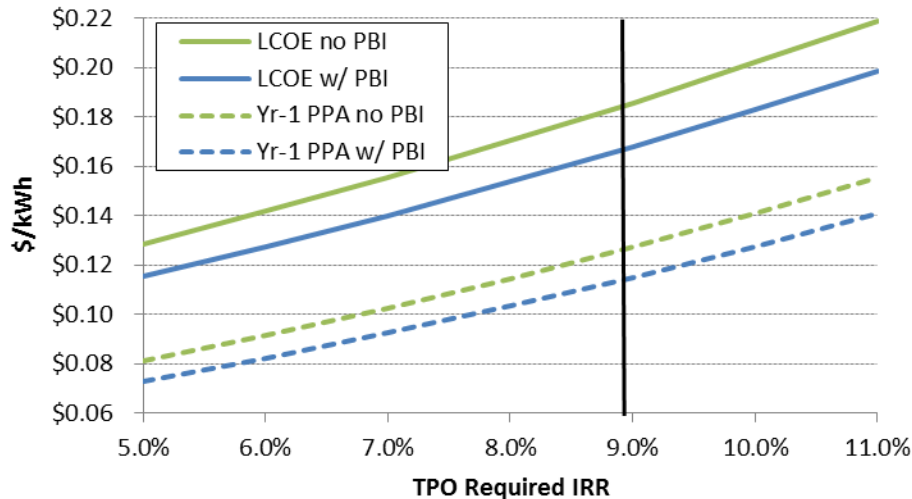
LCOE and Yr 1 PPA vs. Installed Cost



LCOE and Yr 1 PPA vs. PPA Escalator



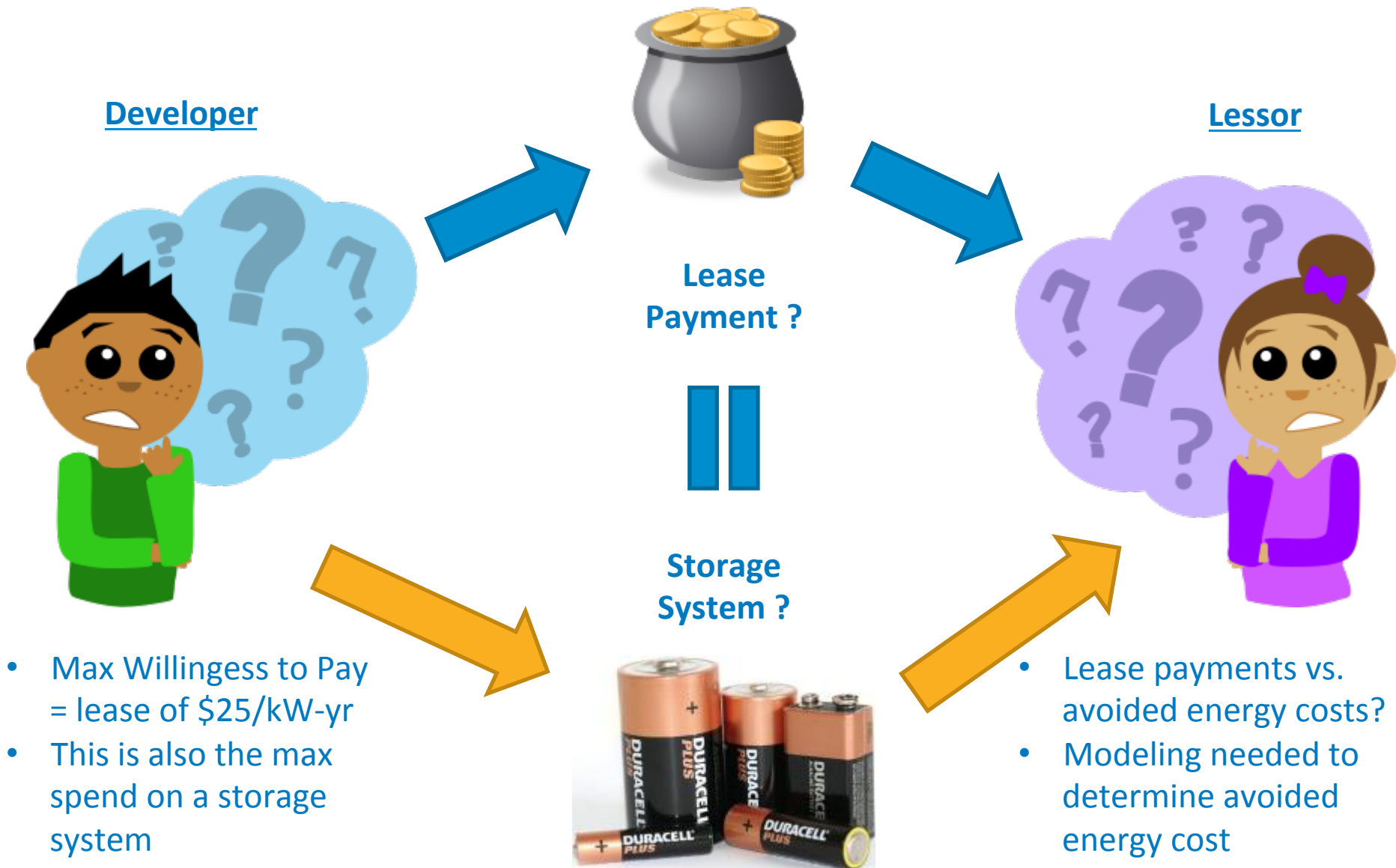
Levelized and Yr-1 PPA vs. TPO IRR



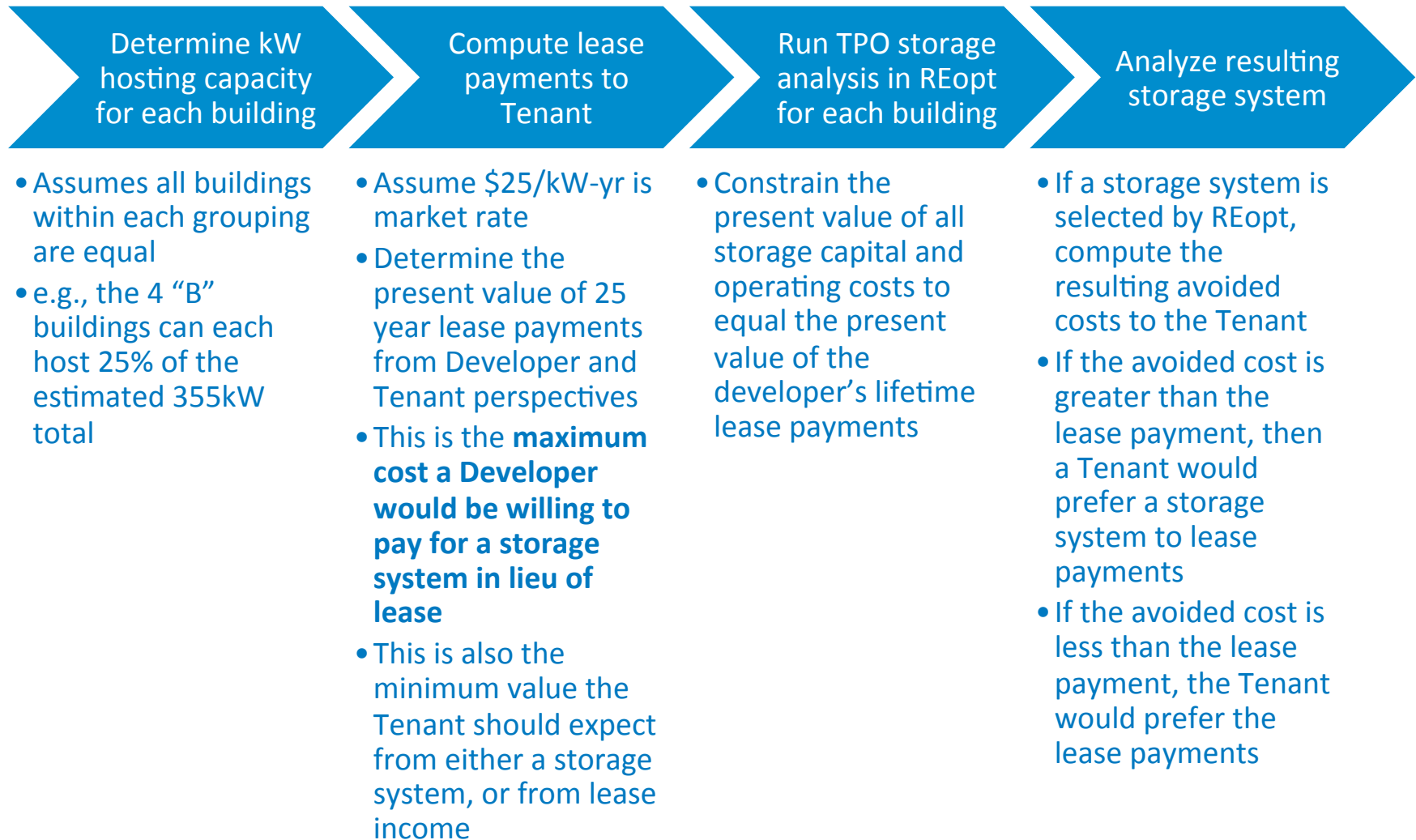
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Storage In Lieu of Lease Concept: What to Compare?



Storage In Lieu of Lease Payment Analysis Steps



Storage In Lieu of Lease Payments Do Not Appear Feasible

- For all buildings analyzed, Tenants realize better value from a lease payment of \$25/kW-yr as compared to the avoided costs generated by a storage system
- Conversely, a Developer may prefer providing systems in lieu of making lease payments as this could result in a lower lifetime cost
- However, practicalities of owning/operating a storage system may limit Developer enthusiasm for this type of solution, unless additional revenues can be realized from the storage systems

	A1516	B11516	B21516	B M1 31516	B41516	C1516	C21516	D C1516
Max PV hosting capacity, kW	1,000	88.75	88.75	88.75	88.75	250	250	1,000
Annual Roof Lease, Cost to Developer/Income to Tenant	\$25,000	\$2,219	\$2,219	\$2,219	\$2,219	\$6,250	\$6,250	\$25,000
Present Value to Developer, 25 yr Roof Lease Cost	\$(247,568)	\$(21,972)	\$(21,972)	\$(21,972)	\$(21,972)	\$(61,892)	\$(61,892)	\$(247,568)
Present Value to Tenant, 25 yr Roof Lease Income	\$319,584	\$28,363	\$28,363	\$28,363	\$28,363	\$79,896	\$79,896	\$319,584
REOPT RESULTS								
Storage Power, kW	-	8.1	4.5	7.5	8.1	-	-	70.4
Storage Capacity, kWh	-	8.1	6.1	9.6	8.1	-	-	123.7
Tenant's Year 1 Avoided Cost from Storage	-	\$1,478	\$814	\$1,376	\$1,529	-	-	\$14,971
Tenant's Annual Lease Income	\$25,000	\$2,219	\$2,219	\$2,219	\$2,219	\$6,250	\$6,250	\$25,000
Makes Sense for Tenant?	NO	NO	NO	NO	NO	NO	NO	NO

Brian Newton

Interim City Administrator/
Dept. of Utilities GM



City of Fremont Utilities – What we provide.

Customer owned:

- Electricity
 - 15,200 customers
- Natural Gas
 - 11,000 customers
- Water
 - 11,200 customers
- Wastewater
 - 11,000 customers



Electric Power

- Baseload Power Plants

- Lon D Wright – coal-fired generating station
 - Unit #6 – 16.5 MW
 - Unit #7 – 21 MW
 - Unit #8 – 91.5 MW
- Derril G Marshall Generating Station – gas-fired
 - 41.6 MW of peaking power

- Grid Power

- Southwest Power Pool (SPP) – Market-based rates
 - 60MW limit

- Renewable

- Cottonwood Wind Farm – 40 MW (November 2017)
- Community Solar – 1 – 3 MW (Summer 2017???)



DOE - Solar Program Technical Assistance Grant

- Why ask for help?
- Request:
 - Look at various pricing models
 - Municipal-owned
 - Customer-owned
 - Power Purchase Agreement
 - Tax incentives
 - Clean Renewable Energy Bonds
 - Investment/production tax credit
 - Customer survey
 - Listen to customers
 - Educate



Community Solar Survey

(Smart Energy Power Alliance)

- Surveyed:
 - Residential accounts (+/-10,000 households)
 - July 18 through August 31, 2016
- Survey instrument:
 - Web-based (Survey Monkey administered by SEPA) – 184 completed
 - Paper-based (bill stuffers) – 236 completed
- Survey format:
 - Explanation of community solar
 - Eleven survey questions about solar interest
 - Three demographic questions



Community Solar Survey Results

- 70% interested in community solar
- Most appealing aspects of community solar

| Reduces dependence on fossil fuels (61%)

| Good for the environment (57%)

| Potential to provide subscribers financial benefits (52%)

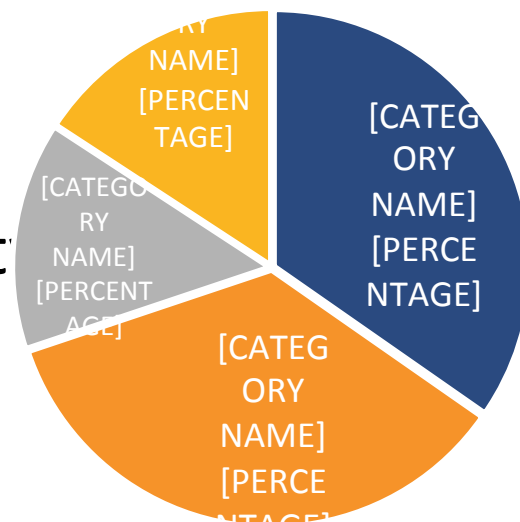
| Doesn't require a rooftop (29%)

| Employment for local worker (27%)

| No maintenance and minimal upfront costs (22%)

| Located within the community (15%)

| Uses new solar technology (11%)



Customers Interested in Community Solar

Community Solar Survey Results

- Most important

- | Initial cost (90%)

- | Long-term savings (82%)

- | Contract length (69%)

- | Who owns Renewable Energy Credits (43%)

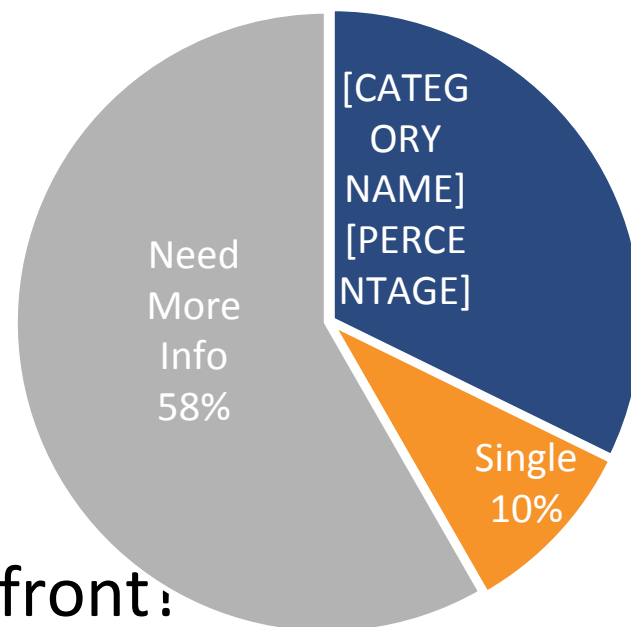
- | Location of solar farm (36%)

- Payments – monthly versus upfront:

- 58% need more information

- 32% willing to pay monthly

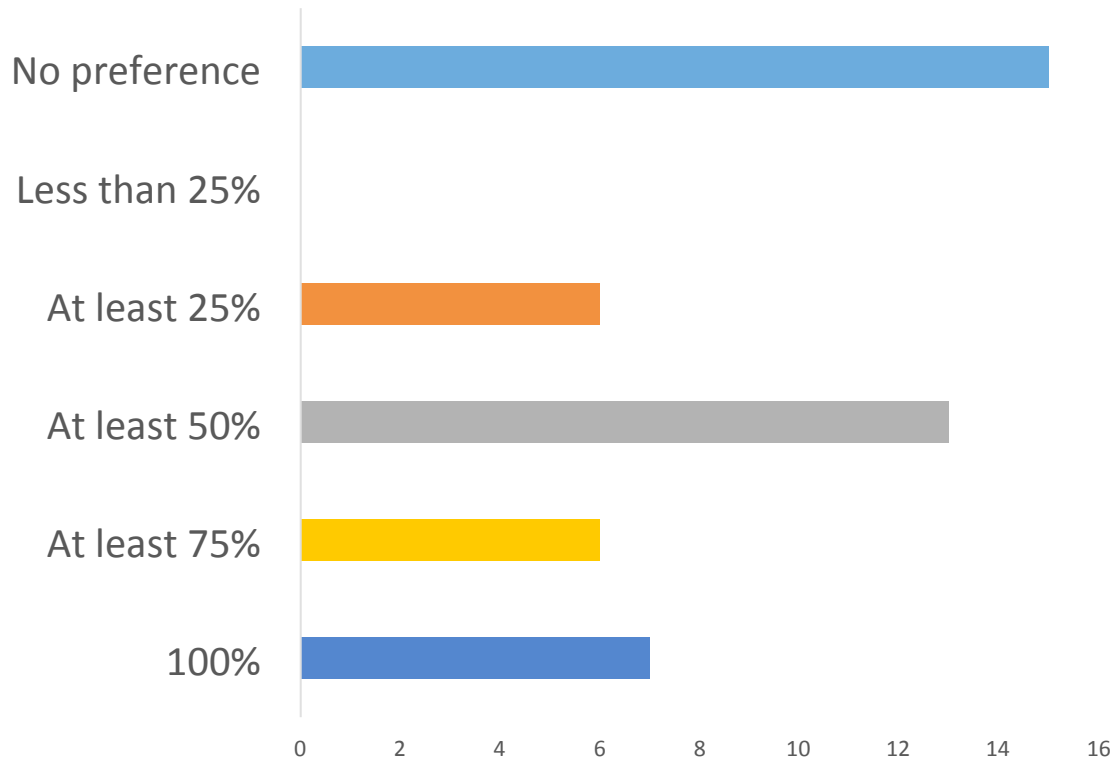
- 10% willing to pay one-time



Payment Arrangements

Community Solar Survey Results

- What percentage of your monthly bill would you supplement with solar?



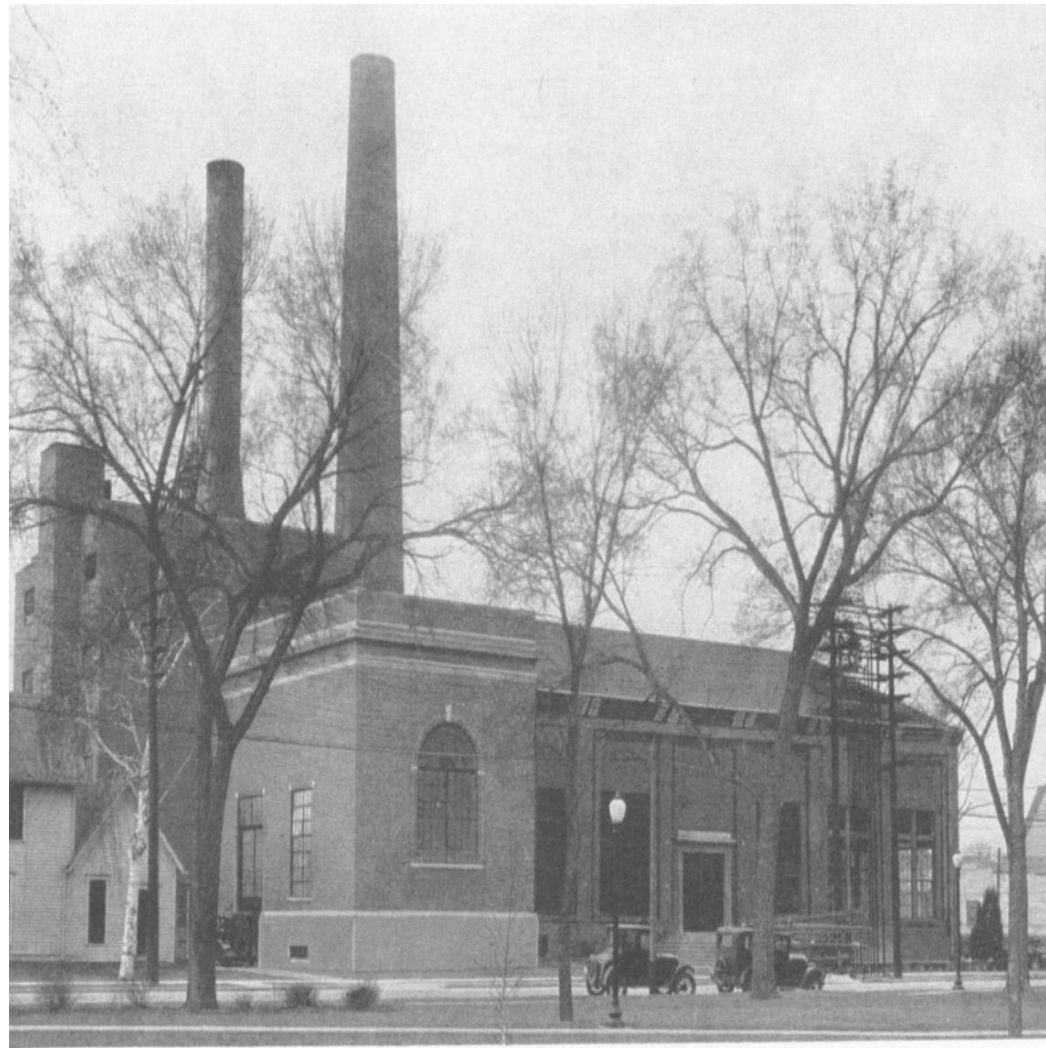
Community Solar Survey Recommendations

- Education, education, education
 - 35% do not understand community solar
- Payment
 - Survey respondents are price sensitive
- Billing
 - Virtual net metering
 - Fixed blocks of solar energy
- Length of term
 - Minimum, but as short as possible



Brian Newton
Interim City
Administrator/
Dept. of Utilities GM

Fremont, Nebraska



FREMONT MUNICIPAL ELECTRIC AND WATER PLANT

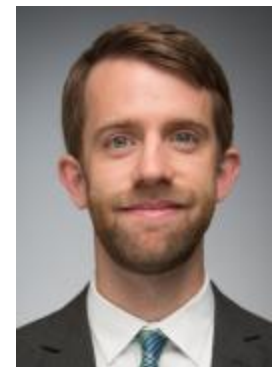
1928



Community Solar Project Finance for Municipal Utilities

Emerson Reiter (presenting for Jason Coughlin)

December 8, 2016



Analysis

- Based on local utility retail rates and the local cost of solar, can a municipally-owned community solar project be attractive to potential subscribers (i.e. competitive with retail rates)?
- Can municipal ownership with access to low cost of debt offset the benefits of the Investment Tax Credit (ITC) and accelerated depreciation via MACRS?

Fremont Dept. Of Utilities

Assumptions:

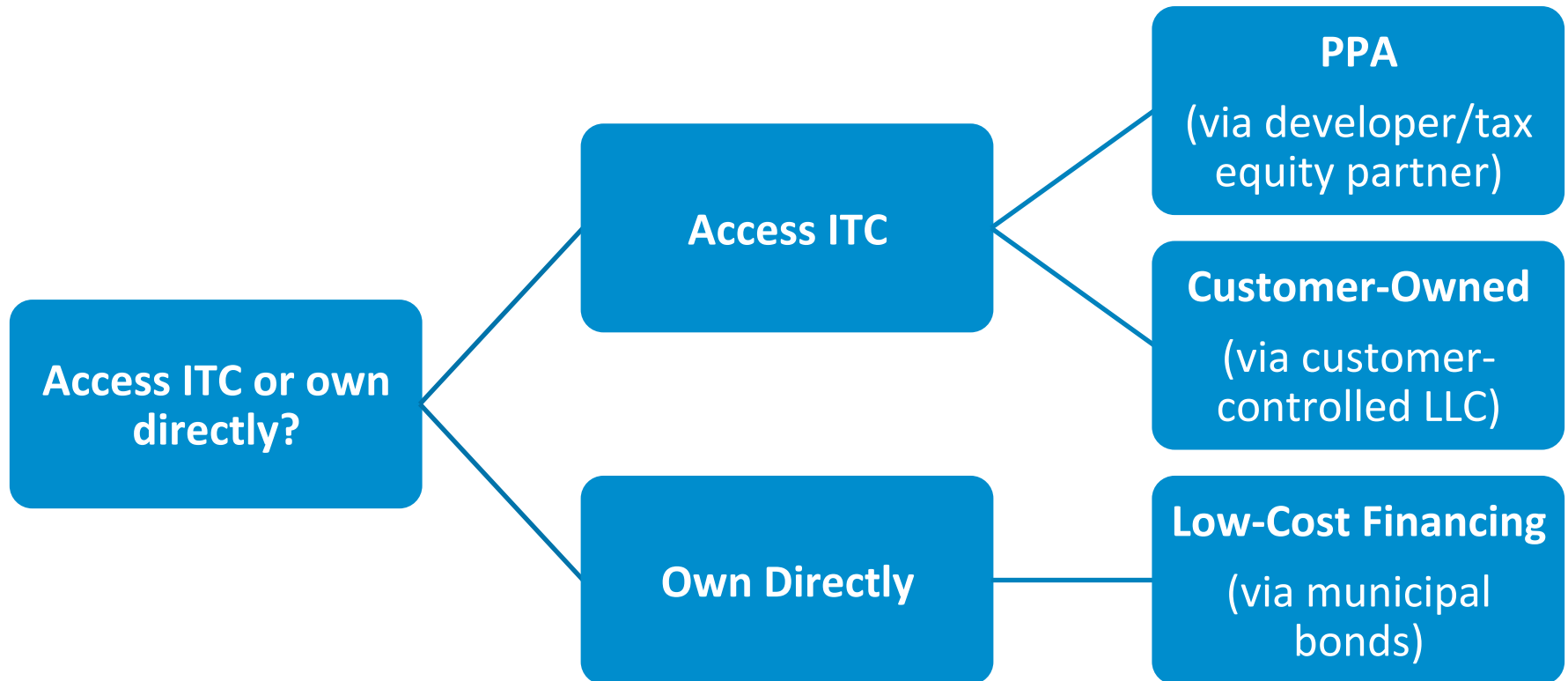
- 1000 kW Community Solar Farm
- \$2.50/W
- 100% debt financed at 4% for 20 years
- Retail residential utility rates = \$0.09/kWh but excess generation credited at \$0.04/kWh
- PPA bid at approximately \$0.08/kWh
- Utility preference to own system if possible

Results if utility-owned:

- Nominal LCOE of \$0.15/kWh (includes O&M)
- Monthly cost per 1 kW subscription = \$16.58 (111 kWh)
- Monthly premium above retail rates for community solar = \$6.62
- One time upfront payment: \$2,512 (\$2.51/W)

Simplified Project Finance Decision Process

Key decision: access the ITC or own using low-cost bonds?



Follow-On Considerations

- Power Purchase Agreement (PPA)
 - Will developers bid on the project?
 - Is rate competitive with other wholesale power?
 - Can utility absorb ancillary costs?
- Customer-Owned Limited Liability Corporation (LLC)
 - Do customers have tax appetite for ITC share?
 - Do customers have capital to put into LLC?
 - Are customers comfortable with tax credit issues?
- Utility-Owned System
 - Can utility offer additional savings (land, O&M, etc.)?
 - Is there operational value to utility ownership?

For More Details

- **NREL Lessons Learned on Community Solar for Municipal Utilities (coming soon!)**
- **NREL Community Solar Scenario Tool:**
a “first cut” financial analysis of various community solar program models
http://www.nrel.gov/tech_deployment/tools_community_solar.html
- **Solar Market Pathways Community Solar Toolkit:**
resources on financial structures, private letter rulings, securities law
<http://solarmarketpathways.org/toolkit/community-solar/>
 - Coming soon: Community Solar Costing Tool
(from Cook County project team)

Questions



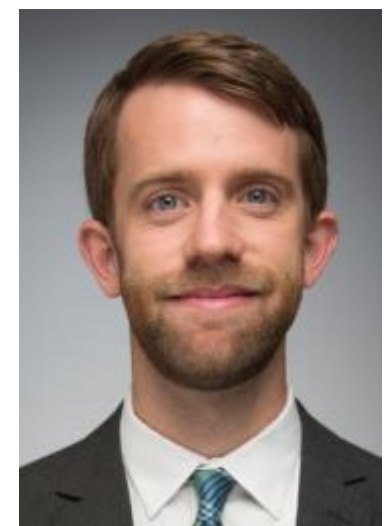
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- Shape the discussion and signup for DGIC alerts:
http://www.nrel.gov/tech_deployment/dgic.html
- Webinar slides and recording available here also!